and blood; the general symptoms being, first, a great fall of the body temperature, and a condition of stupor, ending in death.

3. The activity of both these proteids is destroyed by moist heat. In solution the activity of the globulin is destroyed at between 75° and 80° C., and that of the albumose between 80° and 85° C.

4. That abrus-poison resembles snake-venom in chemical composition, in the local lesions produced, in producing a fall of body temperature, in causing semi-fluidity or fluidity of the blood after death, and, to some extent, in the effect of moist heat on it. Abrus-poison is, however, much less active than snake-venom.

The following table shows a comparison between the activity of the venom of various snakes and of Abrus:—

Vipera berus (common adder)	Fatal dose in man 0·0021 gram per kilo. of body weight (Fontana).*
Hoplocephalus curtus (Australian tiger snake)†	Fatal dose in dog, 0·00485 gram per kilo. of body weight; $\frac{1}{2}$ a grain in medium size dog (15 lbs.).
Cobra	Fatal dose in dog, 0·000079 gram per kilo. of body weight; $\frac{1}{10}$ grain in dog weighing 18 lbs. (Vincent Richards).‡
Abrus-poison:	
Globulin	Fatal dose, 0·01 gram per kilo. of body weight.
Albumose	Fatal dose, 0·06 gram per kilo. of body weight.
Peptic albumoses	Fatal dose in dog, any dose over 0·3 gram per kilo. of body weight (Pollitzer).§

IV. "On the Early Development of *Lepidosteus osseus*.—Preliminary Notice." By J. Beard, Ph.D., B.Sc., Zoologist to the Scottish Fishery Board, Edinburgh. Communicated by Professor T. H. Huxley, F.R.S. Received April 20, 1889.

In the spring of 1888 I journeyed to North America for the purpose of collecting material for a study of Ganoid development.

I sought and found even more material than I wanted in the now well-known habitat of *Lepidosteus*, Black Lake, N.Y. No better hunting-ground could be wished for by the morphologist in search of Ganoid material. The lake contains *Amia*, multitudes of *Lepidosteus*, and (it is said) sturgeons. One need not be at much trouble in seeking sturgeons, for the River St. Lawrence, which flows within 12 miles of Black Lake, will vie with any Russian river. I made the

* Quoted in Marx, 'Gift-Lehre,' vol. 2, p. 74.

† "Report of Special Commission on Snake-poisoning." 'Australian Med. Journal,' 1876, No. 21, p. 104.

‡ 'Landmarks of Snake-poison Literature.'

§ 'Journal of Physiology,' 1886.

acquaintance of fishermen on the St. Lawrence who assured me, and I often verified the fact with my own eyes, that each one of them catches from 60 to 70 sturgeons per week. Many attempts were made to fertilise sturgeon eggs, but all were unsuccessful, probably the season was too early. *Lepidosteus* material was fairly easily obtained, and a large collection of embryos and many adult fishes were secured.

I owe my thanks to the Government Grant Committee of the Royal Society, for the substantial grant which enabled me to defray the cost of collection, &c., of the material used in the following investigations.

It is proposed to give an outline of the development of *Lepidosteus* during the first three weeks of its life; by the end of this time pretty nearly all the organs are developed, and the larva has acquired many of the adult characteristics. The early development, *i.e.*, that of the first four days, is very difficult of investigation, far more so than that of Amphibia and Marsipobranchii. The reason of this lies with the yolk, for that outside the embryo gives rise to technical difficulties, while that which fills all the cells renders everything blurred and indistinct. Fortunately, much can be made out by means of surface views, and these help very materially in rendering an interpretation of the sections possible.

The Egg.—I have little to add to Balfour and Parker's account. As they state the ripe *eggs* are *spherical bodies* of 3 mm. in diameter. The *egg-shell* is composed of two parts: (1) externally a layer of pyriform bodies, and within it (2) a zona radiata. No micropyle could be detected.

The *pyriform bodies* are certainly modified cells, each with the remains of a nucleus at its outer end. These modified cells have degenerated into a sort of glue, which causes the excessive stickiness of the newly laid eggs.* Such a layer, though less developed than here, is characteristic of the eggs of sturgeons and *Petromyzon.*

In the ovarian egg these "pyriform bodies" are probably nutritive cells to the ovum, for their outer ends near the nuclei contain a number of minute yolk particles.

The inner egg membrane is not composed of two layers either in *Lepidosteus* or in the sturgeon. It is a simple zona radiata, the striæ reaching to the innermost portions of the membrane. The division into two layers, sometimes seen, is the optical effect of thick sections.

Within lies the egg proper. It consists of an outer protoplasmic layer containing small yolk particles, and a central yolk mass, *free from protoplasm*, and made up of much larger yolk plates. There is a large germinal vesicle with membrane, the vesicle containing a rather large number of chromatin bodies.

* In alkalies, baryta, and lime-water the egg-shell swells up, and the two latter reagents are valuable allies in getting rid of the egg membranes in young stages.

When the egg is ripe, the germinal vesicle lies just under the shell in a protoplasmic mass, which is permeated by very small yolk particles. The sturgeon egg has a very similar structure, but the yolk elements are much finer. The males are on the average only half the size of the females, and are very much more numerous than the latter, as others have noted. The spawning takes place between May 20th and the middle of June. Some of the inhabitants of the shores of Black Lake have seen it taking place in July. This appears to me very likely. The fishes only spawn on warm windless days, and if cold weather comes, they may remain away from the "points" for weeks, as Garman already noted.

I observed the spawning on three occasions, on May 24th, June 8th and 9th. In the interval no eggs were laid, though search was made for eggs and fishes every day by my assistants or myself. The spawning takes place during the heat of the day, between 12 and 3 o'clock. A full account of it has been already given by Agassiz, and quoted by Balfour and Parker. The eggs are thickly sown, and cling to the small stones which lie about in the shallow water of the "points."

Certain spots seem to be traditional egg-laying grounds for *Lepidosteus*. The eggs are pretty easily removed from the stones, and my own were hatched out in a Californian salmon hatching apparatus.

Most of the eggs left on the stones fell a prey to fungi, and very few indeed hatched out. With care and constant attention a much greater percentage can be hatched out in the apparatus. The difficulties of the investigation prevented the observation of the formation of polar bodies. The segmentation is very rapid, and a cap of small cells is formed in the course of five or six hours. The segmentation is very unequal *but in a sense complete.* Eight furrows can be traced to the centre of the lower pole. The attempt to segment the lower hemisphere is, however, soon given up, none of the eight furrows penetrate very deeply into the yolk, and none reach the centre by a long way. They are only superficial furrows.

The cell cap of the upper pole increases rapidly by divisions within itself, and by the addition of fresh segments from the incomplete segments below its margin. It grows over the yolk, and in the course of 24 hours or less completely encloses the latter. A beautiful circular blastopore is formed, from which a yolk-plug projects as in Amphibia.

Before the close of the blastopore, the region of the future embryo is marked out by a blastodermic thickening, extending forwards from the edge of the blastopore.

A groove marking the axis of the embryo soon appears in this thickening. It must be remarked that this groove appears only just before the closure of the blastopore, and hence it cannot in *Lepidosteus* be regarded as part of the latter.

The blastopore closes on the second day, and *at no time is a canalis neurentericus formed.*

The embryo becomes more and more distinctly marked out, and the nervous system is differentiated.

By-and-bye the embryo gets raised above the level of the blastoderm, and a solid tail-bud is very early rounded off above what was the anterior margin of the blastopore.

The *mesoderm* or *mesoblast* arises very early, and before the close of the blastopore.

If embryologists have not yet agreed as to its mode of origin in the chick, how can one hope to settle this question in the difficult material of *Lepidosteus*? It appears to me to arise from the epiblast on each side of the middle line, and from the epiblastic region at the lip of the blastopore.

I make these statements with the utmost diffidence. Apart from its medium thickening, *the epiblast* is very early divided into two layers. The outer or covering layer (*Deckschicht* of the German authors) takes no share in organ formation at all. It covers the embryo everywhere, but no organs are formed from it. It may, perhaps, be compared to the skin of a larval Annelid. The inner layer may be spoken of as the *formative epiblast.*

The hypoblast has only a dorsal or neural extension, the ventral side of the embryo being occupied by yolk.

Epiblastic Organs. Nervous System.—This is formed solely out of the formative epiblast, though it must be noted that the outer layer is often grooved in the middle line. It may be regarded as a folded plate of epiblast, which sinks below the rest of the formative epiblast, and it differs solely in its mode of formation from the nervous systems of Elasmobranchii and *Amphioxus* in that the folds are closely applied to each other, and only separate later on in development. The brain vesicles can soon be distinguished, and in later stages a similar apparent segmentation can be traced for some distance along the spinal cord. The nervous system becomes hollowed out by the separation of its walls from each other. The optic vesicles arise as a pair of hollow evaginations of the fore-brain. The lens also is a product of the formative epiblast.

In the central nervous system two structures are very early distinguishable:—

(1.) The transient *giant ganglion cells* in the spinal cord; these are described in a separate section (p. 117).

(2.) The *ciliated groove* which I have elsewhere described as forming the floor of the primitive central canal. It persists in the adult, and there also forms only the floor of the central canal as in sharks and elsewhere.

The Brain.—The fore-brain roof in embryo and adult is very thin,

non-nervous, and epithelial in character, as in Marsipobranchs, Teleostei, and other Ganoids (*Acipenser*, *Polypterus*, and *Amia*).

The nervous elements of the fore-brain are represented by thick basal and lateral structures of a solid nature, forming the so-called "corpora striata." To what extent they are homologous with corpora striata shall be discussed in my full paper. To my mind there appears to be no evidence to show that the fore-brain region of Marsipobranchii, Teleostei, or Ganoidei is a degenerate structure. The pineal gland and the nervous part of the pituitary body or hypophysis cerebri have the usual mode of formation. In the adult, the pineal body arises by a hollow stalk from the roof of the thalamencephalon, and it proceeds forwards over the epithelial roof of the fore-brain, ending in a large simple flattened vesicle. This vesicle has a striking resemblance in structure to the same organ in *Myxine*. It lies in a mass of adenoid tissue, which, however, is no part of the pineal body. Waldschmidt's statements under this head in *Polypterus* will require modification.

The first development of the oral part of the hypophysis cerebri is difficult of investigation, on account of the distortion produced by the developing suckers. It arises as a medium solid ingrowth of the formative epiblast, slightly in front of, or almost within, the mouth involution. Its direction is towards the infundibulum and the end of the notochord. It does not become hollowed out as in many other forms.

In the adult the hypophysis cerebri possesses a more complicated structure than the same organ in *Polypterus*, containing as it does glandular epithelium, lymphoid tissue, and degenerated nerve-cells. Its duct does not persist as in *Polypterus*.

Regarding the spinal cord, only one further remark need be made, that is, that behind the anus it is for some time solid.

The Nerves, Ganglia, and Peripheral Sense Organs.

As Balfour and Parker state, the nose is formed as an invagination of a certain portion of the formative epiblast. This is not remarkable when we remember that no organs are formed from the outermost layer.

The ear arises in the same way. The otoliths of *Lepidosteus* and *Salmo* are formed similarly to the otoliths of Invertebrates. Certain cells of the lining of the auditory vesicle become freed from the epithelium, and lie loosely in the auditory cavity. They acquire a position in rows just over the sensory hairs. The cells become calcified, and their nuclei disappear.

The otoliths are probably formed by the fusion of a number of these calcified bodies.

The lateral or branchial sense organs are also products of the formative epiblast.

The cranial and spinal ganglia are formed as recently described by me in sharks and birds.

In the mouth involution also the formative epiblast is alone concerned, the covering layer passes over from the anterior end of the head to the yolk sac. The mouth breaks through about the fourth day. The anus arises as a solid ingrowth of the formative epiblast in the place where the blastopore once existed.

The Larval Suckers.—These organs also are products of the inner or formative epiblast. They are developed very early, and commence to be differentiated about the third day of egg development. They are formed as a number of closed spherical sacs, one part of the wall being thin, and this part is ruptured when they break through the skin a day or two before hatching. One of these sacs is median, and arises almost within the mouth involution. It could almost be mistaken for the developing hypophysis, were it not for its subsequent fate and for the fact that it is directed forwards. When it breaks through the skin it forms a flat glandular plate on the roof of the mouth. From its position it can hardly be of much use as a sucker.

The functional suckers are composed of two sorts of cells: (1) Long glandular cells with hyaline slightly granular contents and nucleus lying near the inner end of the cell. Between these (2) supporting cells with nucleus in the middle of the cell.

Each glandular sucker has the structure of and is probably serially homologous with the suckers of larval Anurous Amphibia. During the period at which they lie beneath the covering epiblast, and for a short time after, the arrangement of the suckers is distinctly bilateral. The median one appears to be unpaired at all stages. They form a complete circlet on the disk, with additional suckers within the circle. On the whole, the organ may be said to be composed of two fused circlets of suckers. Balfour and Parker noticed the numerous vascular channels in the mesoblast just inside the suckers.

The young *Lepidosteus* I possessed did not make use of the suckers for several days after hatching.* The suckers commence to degenerate when the young fishes are about three weeks old.

The pad at the end of the adult snout occupies the position of, but cannot be considered as arising from, the larval suckers. The latter are transient organs.

Hypoblastic Organs.—The origin of the notochord is not yet clear to me, for it arises during an epoch in which the processes of development are difficult of interpretation on account of the yolk.

There is at first a solid œsophagus, as Balfour and Parker state, and the posterior gill clefts arise as solid evaginations from it. The

* The first batch of eggs hatched on the ninth day, the second on the seventh.

spiracular cleft or rather its rudiment is a very early formation, being developed long before hatching. The evagination to form it reaches the formative epiblast and fuses with it, this fusion persisting for a long time, but at no time can a lumen opening on the exterior be detected. As Wright has shown, a part of the spiracular cleft persists in the adult in the form of a canal leading upwards and forwards into the region of the periotic capsule.

The first branchial cleft is formed long before the others and before hatching. In newly hatched larvæ it has a wide opening on to the exterior. This opening soon becomes apparently less by the growth of the operculum.

The pneumatocœle arises at a very early period and long before hatching. It is a fold of the neural median hypoblast, and grows backwards in length apart from connexion with the alimentary canal. For some time the ventral part of the alimentary canal is only filled in by yolk, by-and-bye the gut becomes shut in by ingrowths from the sides in the manner suspected by Balfour and Parker.

The *somites*, like the mesoblast from which they are formed, are at first solid: they are long and narrow. As is usual, their mode of formation is from before backwards; but in front of the first one formed, two others appear later on just behind the auditory capsule. These latter are, as their fate shows, the two anterior somites of the hypoglossus. Regarding head-somites, I prefer at present to say nothing.

The inner wall of the somites gives rise to muscle, and most of the outer wall is converted into pigmented connective tissue. The somites become much elongated, and their ends are constricted off as buds to form the musculature of the paired and unpaired limbs. Each end of each somite constricts off a single bud, which only divides into two at a later stage than the twenty-first day. The posterior paired fins only begin to develop towards the end of the third week, and the muscle buds of the unpaired fins remain in an embryonic condition beyond this period.

Urinogenital System.—To form the *pronephros* there is a solid evagination of the mesoblast, uniting the somites with the somatopleure and splanchnopleure. This arises early on the third day, and reaches from the 4th to 8th or 9th somites inclusive. This probably fuses with the epiblast, and at any rate a solid segmental duct is formed—probably from the inner epiblast layer. This grows gradually backwards, having at first an indistinct form of termination, finally it reaches the proctodæum, and becomes fused with it.

After this stage, two additional mesoblastic somites are formed behind the auditory vesicle. Then the first three somites behind the ear are those of the hypoglossus, and, as van Wijhe has determined

in Elasmobranchii, the pronephros begins at the third definite body-somite, or, counting the three hypoglossus somites, at the sixth. Its extension backwards varies, but the region of three somites is always concerned in its formation. It may extend at first over five or six somites, but the part beyond the anterior three soon aborts. In some cases it has a greater extension on one side of the body than on the other.

Three funnels seem, as a rule, to be formed on each side of the body, but the most posterior of these disappear, two pairs being left. These persist throughout the larval period. The ciliated openings into the body-cavity become narrowed. By this narrowing of the opening, and the widening of the part opposite to the glomerulus, the pronephric chamber described by Balfour and Parker arises. It need scarcely be remarked that there are two of these "chambers" on each side. Even when the mesonephros is in course of development, *i.e.*, from the 16th to the 18th day, the two funnels on each side still persist and are quite distinct.

As just stated, the *mesonephros* arises between the 16th and 18th day. The date of its development seems to be variable. Its tubes are formed in the angle of the body-cavity between the region of the segmental duct and the genital ridge; the latter is at this period part of the mesentery of the alimentary canal. One notices that the cells of this region of the cœlom are filled with yolk. These yolk-filled cells give rise to the mesonephros and the genital glands. The storing-up of yolk reminds one of Dohrn's discovery of yolk-laden cells in the head-somites of *Ammocœtes*, *i.e.*, in those structures which at a much later period form the eye-muscles of the *Petromyzon*. At the 16th day the somites have been almost entirely converted into muscle and connective tissue, and in *Lepidosteus* the mesonephros can neither be derived from the part connecting the somites and body-cavity together, as in Elasmobranchs and birds (Sedgwick; van Wijhe), nor from part of the somites (nephrotome of Rückert). There is here no intermediate cell-mass as in the chick, but the mesonephric tubules arise as distinct segmental evaginations of the wall of the body-cavity at the point indicated above. They grow over the segmental duct in a curved fashion, and open into it by piercing through its wall.

Such is the brief account of the early development of *Lepidosteus* which I feel at present in a position to give, and I close this communication with a notice of—

A Transient or Larval Nervous Apparatus in Lepidosteus and certain other Ichthyopsida.

In the course of my investigations I noticed the very frequent occurrence of "giant ganglion cells" in a particular situation along

the whole length of the spinal cord of *Lepidosteus* and certain other fish embryos. So little had hitherto been published about their occurrence in different groups of fishes, that a comparative investigation of the matter seemed desirable; all the more, as I soon arrived at conclusions as to their meaning and fate very different from those of Dr. Paul Mayer, the only author who has paid much attention to such cells (in the Scylliidæ). In all cases these giant ganglion cells occupy the same typical position in the extreme dorsal or neural border of the spinal cord. They are found in very young embryos in nearly every transverse section through the region of the spinal cord. Very often a pair, one on each side of the middle line, is met with in a single section. To obtain a clear insight into their distribution horizontal longitudinal sections are necessary. When the sections of such a series are examined, one notices that the first sections which pass through the dorsal or neural limit of the spinal cord, contain a large number of rather large ganglion cells, and it can easily be verified that the roof of the spinal cord along its whole length is composed of similar cells, which form a double row reaching from the termination of the hind-brain to the posterior limit of the central nervous system.

Their occurrence in the brain region proper is very doubtful; as they appear to extend forwards only as far as the anterior boundary of the hypoglossus region. That is, in early stages they can be traced as far as those somites which belong to the hypoglossus.

They are the first cells in the embryo which develop ganglionic characters, and they are fully developed in young embryos long before the remaining cells of the nervous system become ganglionic. The cells are multipolar; and in some cases processes can be seen passing from them into the developing spinal cord, but I cannot say how they are connected with other nervous elements. Possibly they are paired; at any rate, in many cases they are bilaterally arranged, and in the region of each mesoblastic somite in the different fishes to be presently mentioned from four to eight pairs of such cells occur. The exact number can only be determined by means of reconstructions of embryos. There is probably a defined number of them in every embryo of each species, and this number must be several hundred.

The most remarkable circumstance is their fate, which I have so far fully determined in *Scyllium*, *Pristiurus*, *Lepidosteus*, *Salmo*, and *Triton*.

On the Formation of the Permanent Central Canal of the Spinal Cord.

These Ganglion Cells are all shut out of the Central Nervous System. Their processes are either withdrawn or cut off, more probably the latter, and their poles now present a curious stumpy appearance. The

cells persist for a long time, lying outside the cord, and on its dorsal or neural surface, just over the posterior fissure.

Gradually they undergo a series of degenerative changes. The stumpy processes vanish; the cells shrink, and so get smaller. Finally, they become glassy, having lost all traces of nucleus and nucleolus, and disappear.

In fact, the series of changes undergone by these cells corresponds exactly to that degeneration and death of nerve-cells, which the pathologists term simple atrophy (*einfache Atrophie*, see Ziegler's 'Pathologische Anatomie,' 3te Auflage, 2ter Theil, pp. 603—606). Though the presence of giant ganglion cells in the embryos of certain Scylliidæ was known,* till now we had no idea of their distribution over the whole spinal cord as stated above. Like Dr. Mayer, I find them in *Scyllium* and *Pristiurus*, in both of which forms they are exceedingly large, numerous, and well developed. Along with Mayer I failed to detect them in *Torpedo*, but met with them in *Raja.* I also miss them in *Acanthias*, but in *Mustelus*, where as a normal thing they do not develop, one may find about a dozen of them well developed in a single embryo, but then in abnormal situations, lying free in the formative tissue of the mesoblast, and outside the central nervous system. They are very obvious in 10 millimetre embryos of *Salmo*, and may easily be detected in *Labrax*, *Esox*, and *Rhodeus* embryos of the proper age. They are very numerous in newly hatched *Lepidosteus.* Only with difficulty can they be demonstrated in young *Petromyzon* embryos, on account of the yolk filling the cells, but they are certainly present in this form. At present I do not possess sufficient material to follow their fate in *Petromyzon*, but doubtless it is the same as in the three groups represented by *Scyllium*, *Salmo*,† and *Lepidosteus.*

In *Raja*, *Labrax*, *Esox*, and *Rhodeus*, I have not followed all stages of their degeneration, but I have studied this sufficiently to be sure that their fate is that of the ganglion cells in the groups just mentioned. They may be found in larvæ of *Rana* and *Triton*, and in the latter form they have the usual fate—that I have determined. *It is very significant to notice that the forms in which they normally occur are, without exception, oviparous.*

The abnormal occurrence of a dozen or so giant ganglion cells in *Mustelus* and their presence in *Raja*, coupled with their absence in *Torpedo*, are interesting facts, which point to the conclusion that the viviparous Elasmobranchii once possessed them as a normal development.

The giant ganglion cells which occur in adult *Amphioxus* and

* Paul Mayer: "Die Unpaaren Flossen der Selachier." 'Mittheilungen Zool. Stat. Neapel,' vol. 6, pp. 228—229.

† They probably occur in nearly all Teleostei. According to Eisig they have been seen by P. Mayer in many marine forms belonging to this group.

Petromyzon appear to have no homology with these larval ganglion cells.* The proof of this statement is impossible without figures. I hope to show, in a fuller paper on the early development of the central nervous system, that in *Scyllium* giant ganglion cells are developed in deeper portions of the spinal cord, and that these cells have exactly the situation and characters of the well-known giant ganglion cells of *Amphioxus*.†

In the same sections of *Scyllium* embryos the two sorts of cells can be seen; the one deeply situated in the cord, and with well developed processes, the other outside the nervous system, and greatly degenerated.

I will here only remark that I cannot support Mayer's conclusions‡ as to the fate of these giant ganglion cells, and defer a discussion of his views until I have followed the history of these cells in *Petromyzon*.

I may here point out, however, that Kleinenberg§ appears to me to have been quite right when he suspected that the cells described by Mayer might be analogous to certain sub-umbrellar ganglion cells in the larva of *Lopadorhynchus*, which "introduce" the development of the ventral cord: and that, just as in the Annelid, the development of the vertebrate central nervous system would appear to have been initiated by a larval nervous apparatus outside the same. I propose to discuss this question in a future paper.

V. "The Assimilation of Carbon by Green Plants from certain Organic Compounds." By E. HAMILTON ACTON, M.A., Fellow of St. John's College, Cambridge. Communicated by W. T. THISELTON DYER, C.M.G., F.R.S. Received April 20, 1889.

(Abstract.)

The recent synthesis of a true glucose ("Acrose")|| by Fischer and Tafel, and additions to our knowledge of the structure of dextrose and lævulose by Kiliani,¶ &c., seem to render desirable fresh experiments on the synthetical production of carbohydrate in green plants from sources other than CO_2 (*i.e.*, from organic compounds in which C is already combined with H and O).

* The homology of the giant ganglion cells described by Fritsch in *Lophius* is doubtful.

† *Vide* the excellent figure (fig. 143) in Hatschek's 'Lehrbuch der Zoologie,' p. 138. Probably *Amphioxus* possesses a transient or larval nervous apparatus.

‡ *Op. cit.*, p. 229.

§ N. Kleinenberg: "Die Entstehung des Annelids aus der Larve von Lopadorhynchus." 'Zeitschr. Wiss. Zool.,' vol. 44, pp. 220–221.

|| 'Deutsch. Chem. Ges. Berichte,' vol. 20, pp. 1088, 2566, 3384.

¶ *Ibid.*, vol. 19, p. 221.